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On-Pavement Signing

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Abstract
Pavement marking legends are placed on the roadway to remind drivers of the speed limit or to slow down. Use of wording on the pavement surface is more dramatic than use of signing only, which can get lost in the clutter of a streetscape. On-pavement speed limit markings have been used to reinforce speed limits or to indicate a transition zone.

For more on this topic by these authors, see also "Evaluation of Dynamic Speed Feedback Signs on Curves: A National Demonstration Project": http://www.trb.org/main/blurbs/172092.aspx

Keywords
Countermeasures, Highway Safety, Road markings, Rural highways, Speed limits, Traffic control devices, Traffic safety

Disciplines
Civil Engineering

Comments
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Description

Pavement marking legends are placed on the roadway to remind drivers of the speed limit or to slow down. Use of wording on the pavement surface is more dramatic than use of signing only, which can get lost in the clutter of a streetscape. On-pavement speed limit markings have been used to reinforce speed limits or to indicate a transition zone (see Figure 1).

Placement

No guidance was found on exactly where on-pavement markings should be placed. However, the use of legends should correspond to vertical signing.

Effectiveness of On-Pavement Curve Signing

Several combinations of on-pavement signings have been previously used to reduce lane departure crashes. These have been applied predominantly on rural two-lane curves. The treatment consists of several variations of a curve sign and other text, such as the speed limit. One study was conducted in Iowa and several studies have been conducted in other states. No studies on use of on-pavement speed limit or other types of on-pavement signing to reduce lane departures were found.

Iowa Studies on Effectiveness of On-Pavement Curve Signing to Reduce Speed

Hallmark et al. (2012) evaluated use of on-pavement markings on two rural two-lane curves in Iowa. The on-pavement treatment consisted of the wording SLOW and a curve arrow sign framed by two bars (see Figure 2). The treatment was placed upstream of the curve in both directions of travel. The team used a thermoplastic product since this material was much more durable than pavement marking paint.

One treatment was applied to a site along County Road (CR) 99 in Des Moines County, Iowa, which has an average daily volume of 780 vehicles per day (vpd) and a tangent speed of 55 miles per hour (mph) with no advisory speed. The second site was along L-20 in Harrison County, Iowa, and has a daily volume of 1,880 vpd with a tangent speed of 55 mph and an advisory speed of 35 mph.

Figure 1. On-pavement speed limit signing along E-18 in Roland, Iowa (Hallmark et al. 2007)

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Figure 2. On-pavement curve signing along CR 99 in Des Moines County, Iowa (Hallmark et al. 2012)

Results of speed analyses are shown in Table 1. As noted, the mean speeds were reduced by 0.7 to 1.8 mph at 1 month after installation and 0.6 to 1.5 at 12 months after.

Similarly, there were changes in 85th percentile speed: -1 to 2 for both 1 and 12 months after installation.

Table 2 shows the change in the fraction of vehicles traveling 5 or more and 10 or more mph over the advisory speed if present or posted speed limit is not present.

Decreases from 1 to 30 percent in the fraction of vehicles traveling 5 or more mph over the advisory or posted speed limit were found at three locations, and an increase of 32 percent was found at the fourth location at 1 month. Similar decreases were found at 12 months. Decreases in the fraction of vehicles traveling 10 or more mph over the posted or advisory speed were found at three of the locations where data were collected (5 to 61 percent) and an increase resulted at the fourth (26 percent). At 12 months, decreases were also found at three locations (2 to 58 percent) and an increase was noted at the fourth (20 percent).

Other National Studies on Effectiveness of On-Pavement Curve Signing to Reduce Speed

Chrysler and Schrock (2005) examined the effectiveness of pavement markings consisting of words and symbols on reducing speeds in rural highway curves. The researchers tested four different markings: transverse lines, CURVE AHEAD pavement markings (see Figure 3), and CURVE 55 MPH pavement markings. The researchers also tested pavement markings with a curve symbol plus 50 MPH on an urban curve.

Each of the markings was applied to the roadway, with the majority applied 400-ft after the standard curve warning sign with text that was approximately eight feet tall. The researchers measured change in speed from an upstream control point to the treatment.

An increase of around 5 mph resulted at the point of curvature (PC) for the CURVE AHEAD signing. Speeds were reduced by one mph for the CURVE 55 mph markings, although an analysis of variance indicated that the difference was not statistically significant. A reduction of 7 mph was reported for the curve symbol plus 50 MPH markings at the urban location (on a divided four-lane highway).

Retting and Farmer (1998) studied the use of pavement markings in the tangent section leading up to a curve and their effects on speed. The researchers conducted this study on a suburban two-lane secondary road in northern Virginia. The study site had a sharp left curve with a 15 mph advisory speed.

The researchers collected before and after data on both a test site and a control site. The researchers used 8-ft white letters spelling SLOW at the test site, along with two white lines perpendicular to the flow of traffic and a left curving arrow (see Figure 4).

Figure 3. On-pavement curve markings (Chrysler and Schrock 2005)

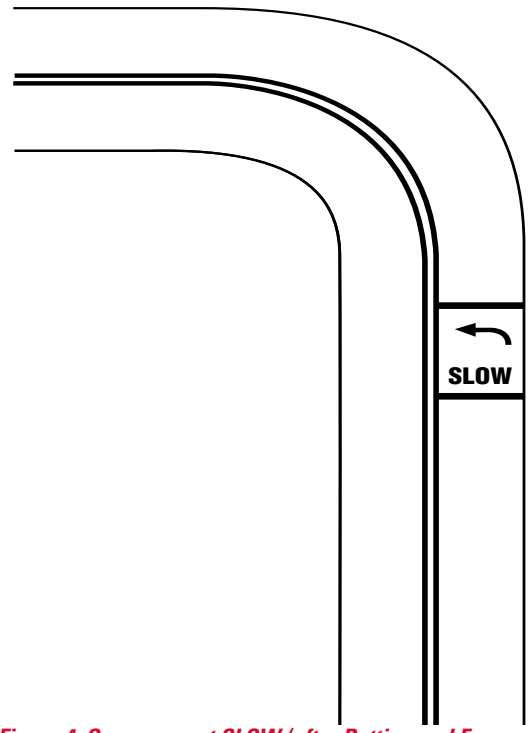

Figure 4. On-pavement SLOW (after Retting and Farmer 1998)

Table 1. Change in Mean and 85th Percentile Speeds for On-Pavement SLOW Plus Curve Sign Framed by Bars (Hallmark et al. 2012)

Location	Mean speed (mph)					85th percentile speed (mph)				
	Before	1 Month	Change	12 Months	Change	Before	1 Month	Change	12 Months	Change
CR 99 North PC SB	55.0	53.9	-1.1	54.3	-0.7	60	62	2	62	2
CR 99 South PC NB	56.4	54.6	-1.8	54.9	-1.5	62	61	-1	61	-1
L-20 North PC SB	51.8	50.9	-0.9	51.2	-0.6	58	57	-1	57	-1
L-20 South PC NB	48.5	47.8	-0.7	47.5	-1.0	54	53	-1	53	-1

Table 2. Change in Fraction over Speed Limit for On-Pavement SLOW Plus Curve Sign Framed by Bars (Hallmark et al. 2012)

Location	Fraction traveling 5 mph over					Fraction traveling 10 mph over				
	Before	1 Month	Change	12 Months	Change	Before	1 Month	Change	12 Months	Change
CR 99 North PC SB	0.20	0.27	32.1%	0.30	48.7%	0.04	0.05	26.5%	0.05	19.8%
CR 99 South PC NB	0.36	0.23	-37.9%	0.25	-30.1%	0.07	0.03	-61.2%	0.03	-57.7%
L-20 North PC SB	0.96	0.96	-0.8%	0.97	0.8%	0.89	0.85	-4.8%	0.88	-1.7%
L-20 South PC NB	0.95	0.94	-0.9%	0.93	-2.1%	0.80	0.74	-7.0%	0.74	-7.0%

Results showed a daytime decrease in mean speed of 1.1 mph and a 5.6 percent decrease in the drivers exceeding the advisory speed by 5 or more mph. At night, a decrease in mean speed of 1.6 mph was observed and 6.1 percent decrease in vehicles traveling 5 mph over the advisory speed. Late night mean speed dropped by 3.4 mph, and drivers exceeding 40 mph dropped by 16.9 percent.

Studies on Effectiveness of On-Pavement Curve Signing to Reduce Crashes

No information was available about the crash reduction impacts of on-pavement marking legends.

Advantages

- Inexpensive
- Can be implemented rapidly
- No increase in noise
- No impact to emergency vehicles
- No adverse effect on vehicle operation

Disadvantages

- Increased maintenance costs
- Not necessarily visible when snow or ice on the roadway

Appropriateness

Pavement marking legends are appropriate for most situations. The skid resistance should be considered, particularly as the treatment wears.

Cost

Costs depend on materials used (paint versus thermoplastic). The treatment is low cost but long-term maintenance does need to be considered.

References

Chrysler, Susan T. and Steven D. Schrock. *Field Evaluation and Driver Comprehension Studies of Horizontal Signing*. Report FHWA/TX-05/0-4471-2. Texas Transportation Institute, College Station, TX, 2005.

Hallmark, Shauna, Eric Peterson, Eric Fitzsimmons, Neal Hawkins, Jon Resler, and Tom Welch. *Evaluation of Gateway and Low-Cost Traffic-Calming Treatments for Major Routes in Small Rural Communities*. Center for Transportation Research and Education, Ames, IA, 2007.

Hallmark, Shauna L., Neal Hawkins, and Omar Smadi. *Evaluation of Low-Cost Treatments on Rural Two-Lane Curves*. Center for Transportation Research and Education, Ames, IA, 2012.

Retting, Richard A., Hugh W., McGee, and Charles M. Farmer. "Influence of Experimental Pavement Markings on Urban Freeways Exit-Ramp Traffic Speeds." *Transportation Research Record* 1705 (2000): 116-121.